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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Using Eddy Covariance to Measure the Dependence of Air-Sea CO_2 Exchange Rate on Friction Velocity" *by* Sebastian Landwehr et al.

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Response to Referee #2

RC : *This paper presents a new corrections of the estimated air-sea CO2 gas flux in ship measurements considering the air-flow distortion. And the air-sea CO2 gas transfer velocity using this corrections showed the smaller variation than the former result. This manuscript contains possibly interesting points for the readers of Atmospheric Chemistry and Physics. However, the Result and Discussion part is not described adequately. The following are the concerns and some suggestions.*

AC : We would like to thank the reviewer for his constructive comments and suggestion. Please find our responses below.

RC : *In Section 3.2, the authors mentioned the residual flow distortion error about the disagreement with COARE 3.5 parameterization. Consequently, the authors should describe the reasons in detail.*

AC : We added the following to Section 3.2:
"For the wind speeds these can be (i) errors in the estimated acceleration/deceleration of the relative wind speed; (ii) errors in the estimated horizontal deflection, which will lead to minor inaccuracies in the correction for horizontal ship velocity; and (iii) errors in the estimated uplift, which would introduce bias in the wind speed normalisation. For the friction velocities, bias in estimates can arise from (i) insufficient removal of the ship-motion signals (MSC) and (NAV); (ii) small inaccuracies in the tilt estimate; and (iii) uncertainties in the estimation of the elevated cospectral energy for n$\geq$ 1 Hz."

RC : *In Section 3.3, The authors should clearly mention about the accuracy of catamaran's data. For example, what is the method of the motion correction for the catamaran's data? And how about the accuracy of the catamaran's wind speed?*

AC : Thanks for the hint, we added the following information to the section 3.3:
"During periods of fair weather, wind speed and direction were also measured by an Airmar PB200 marine sonic anemometer at 5.6 m a.s.l. on the mast of a small catamaran. The PB200 has an RMS uncertainty of 0.5 m s^{-1} at wind speeds $<$ 5 m s^{-1}, which increases to 1 m s^{-1} for higher wind speeds. A GPS incorporated in the unit was used to correct the measured speeds for horizontal platform motion."

RC : *In Section 4.1, since the CO2 gas transfer velocity decrease in the high wind speed in Fig. 8, it is better to add the applicable wind speed range to Eq. (10).*

AC : The observed decrease at high wind speeds is based on only 4 samples from a single high wind speed event. More measurements at wind speeds above 20 m s^{-1} will be necessary to

accurately predict gas exchange at these extreme conditions. Based on SOAP, we suggest that Eq. (10) is applicable to the wind speed range $5 - 19\,\mathrm{m\,s^{-1}}$. Please also refer to response to Referee #1 for more details.